Events and Sightings

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Chemical Heritage Foundation celebrates 40th anniversary of Moore's law

Moore's law is perhaps one of the most widely known and least understood doctrines of modern science and technology. In its most popular formulation, it predicts the doubling every 12 months (or more recently, every 18) of the number of transistors that can fit into a square inch of silicon. Part observation, part prediction, part public relations effort, Moore's law has been harnessed to describe, explain, and extrapolate into the future the rapid computerization of society over the past half-century.

Although not a scientific law in any meaningful sense, it has become a defining fact of life for the semiconductor industry, for information technology more generally, and for all who want to understand (and influence) the history of information technology. Moore's law became a self-fulfilling prophecy that helped drive the industry along and continues to this day largely unabated.

On 12–13 May 2005, the Chemical Heritage Foundation celebrated the 40th anniversary of Moore's law with a seminal conference that included Gordon Moore himself. The focus was on ways in which the semiconductor industry was not just a product of developments in electrical engineering or physics, but was also, according to conference organizers, "in a profound sense, a chemical industry." Although not primarily aimed at historians of computing, it provided insights into new directions for the discipline that have thus far been underdeveloped.

The conference opened with a public reception and lecture by Rodney Brooks, the director of the Massachusetts Institute of Technology's (MIT's) Computer Science and Artificial Intelligence Lab, on the larger social and cultural influences of Moore's law. The next day witnessed a full program of presentations on a broad range of topics.

Patrick Gelsinger, a senior vice president at Intel, addressed one of the more pressing challenges facing the semiconductor industry, namely "When will Moore's law end?" His argument was, in effect, "not soon." As with many of the other speakers, Gelsinger focused on the close relationship between the disciplines of chemistry and electrical engineering. Raj Gupta, chairman and CEO of Rohm and Hahn, elaborated on this theme, and spoke informally about the globalization of semiconductor research and design. Elsa Reichmanis, the director of the Materials Research Department at Bell Laboratories, spoke about the importance of photoresists—themselves chemical products—to the historical development and future of the semiconductor industry and semiconductor technology.

A few of the presentations were more explicitly historical. Carver Mead (professor emeritus, California Institute of Technology) displayed some of the original 36-mm slides that he used to present Moore's law in the early (pre-PowerPoint) era. Harry Sello, who worked as a physical chemist at both the Shockley Semiconductor Laboratory and the Fairchild Semiconductor Corporation, spoke about his own experiences developing the chemical processes essential to semiconductor fabrication. AnnaLee Saxenian, dean of the School of Information Management and Systems at the University of California, Berkeley, described the influence of the semiconductor industry on the Silicon Valley region and its relationship to a host of subsidiary technologies and industries. And Gordon Moore provided a modest and genial overview of his own role in the formulation of the 1965 paper that would later be seen to have introduced Moore's law.

Overall, the conference made a compelling argument for the importance of chemistry and materials science in the history of computing. It's often tempting to think of the computer in the abstract terms of intellectual history rather than as a concrete artifact with inescapable material characteristics. By highlighting the role of chemists and chemical processes in the development of semiconductor technologies, the Chemical Heritage Foundation conference reminds us of the pragmatic challenges posed by the mass production of electronic computers. The shape of computer technology has been as much shaped by the work of largely anonymous industrial and chemical engineers and materials scientists as it has been by pioneering electrical engineers or computer scientists.

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Marconi International Fellowship Foundation award Moore the Lifetime Achievement Award

Columbia University's Guglielmo Marconi International Fellowship Foundation chose Gordon Moore, the author of Moore's law and an Intel cofounder, for its Lifetime Achievement Award. Moore is the third person to receive the Marconi Society's Lifetime Achievement Award during the organization's 31-year history.

The Web site of the Marconi Foundation (http://www.marconifoundation.org/pages/news_room/index.htm) reports that

> Moore is widely known for his 1965 prediction which stated that the number of transistors the industry would be able to place on an integrated circuit would double every year. In

> 1975, the timeline was updated to once every couple of years. While originally published in electronics magazine[s] as a rule of thumb, Moore's Law paved the way for semiconductor engineers to efficiently and inexpensively squeeze more transistors onto an integrated circuit to increase computing performance, creating a worldwide industry standard that has extended computing from the domain of the highly technical to the realm of the eminently practical.

Celebrating the 40th anniversary of Moore's law reminds us of the social impact of semiconductor technology and how it helped downsize computers.

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The Computing before Computers meeting

On 12 May 2005 the Computer Conservation Society held an afternoon meeting titled "Computing before Computers" in the Fellows Room of the Science Museum in South Kensington, London. There were five talks during the afternoon.

Martin Campbell-Kelly from the University of Warwick spoke on large-scale Victorian Data Processing. He described systems such as bank clearing, railway clearing, and small-scale savings that processed thousands of transactions daily by hand.

Raul Rojas from the Freie Universität, Berlin, spoke about his reconstruction of Konrad Zuse's Z3 computing machine of the mid-1930s. He also ran a film showing the machine in action and discussed the value of the machine as a pedagogical device.

Pamela Vass and David Hogan described the late 19th century ternary calculating machine of Thomas Fowler's life and work. They discussed Fowler and demonstrated how his machine was designed to work.

Mary Croarken from the University of Warwick spoke about the 18th-century human computers who calculated the Nautical Almanac.

Jane Wess, senior curator of science at the Science Museum, spoke on arithmetical aids from ancient times to modern pocket calculators. Her talk was richly illustrated by images from the Science Museum's collection.

Doron Swade organized the event and about 80 people attended. The meeting closed with a demonstration of the Science Museum's reconstruction of Babbage's Difference Engine.

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Computer Oral Histories in the IEEE History Center Collection

Recently, as part of a project undertaken for the Marconi International Fellowship Foundation, the IEEE History Center conducted a number of oral history interviews with important computer pioneers. The project involved the history of telecommunications, so there was a particular emphasis on pioneers in data communications.

The center has recently added the oral histories of

- Tim Berners-Lee, the inventor of the World Wide Web;
- Whitfield Diffie and Martin Hellman, who created a system of cryptography based on one-way mathematical functions (public key cryptography);
- Federico Faggin, the designer of the first microprocessor—the 4004 integrated circuit;
- Robert Kahn, who developed much of the network theory underlying Arpanet and its successor—the Internet—as well as co-writing the transmission control and Internet (TCP/IP) routing protocol;
- Leonard Kleinrock, whose distributed routing algorithm and concept of distributed control were key components in making the Internet efficient and flexible;
- James Massey, whose work in error-decoding, multiple accessing, and cryptography have been crucial in data communicatons;
- Robert Metcalf, who built MIT's first Arpanet connection and who invented the Ethernet;
- Gottfried Ungerböck, who developed the system of trellis-coded modulation which led to improvements in high data rate digital communications; and
- Jacob Ziv, of Lempel-Ziv Algorithm fame, whose work in data compression, error-free data transmission, and data security has been crucial to the Internet.

These recent oral histories are in the process of being made available on the IEEE History Center's Web site (http://www.ieee.org/organizations/history_center/oral_histories.html). The IEEE History Center is determined to preserve as source material for the future historians of technology the personal memories of pioneering electrical and computer engineers, the technologists who transformed the world in the 20th century. The center holds more than 400 oral histories in its archives, of which more than 200 are currently available online.

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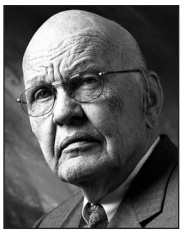
An obituary of Jack Kilby



Jack Kilby (Photo courtesy of Texas Instruments.)

Jack St. Clair Kilby, retired Texas Instruments (TI) engineer and inventor of the integrated circuit, died on 20 June 2005 in Dallas, following a brief battle with cancer. He was 81.

Kilby invented the first monolithic integrated circuit, which laid the foundation for the field of modern microelectronics, moving the industry into a world of miniaturization and integration that continues today. He was awarded the Nobel Prize in physics in 2000 for his role in the invention of the integrated circuit. Kilby considered himself first and foremost an engineer, a profession he viewed as transforming ideas into practical realities. He held more than 60 patents for a variety of electronic inventions. Among these were the handheld electronic calculator and the thermal printer, both of which he co-invented.

In addition to the Nobel Prize, Kilby received numerous honors and awards for his contributions to science, technology, and the electronics industry. He is one of only 13 Americans to receive both the National Medal of Science and the National Medal of Technology, the highest technical awards given by the US government. In 1993, he was awarded the Kyoto Prize in Advanced Technology. Kilby also received the first international Charles Stark Draper Prize—the world's top engineering award—from the National Academy of Engineering in 1989. In addition, he is honored in the US Patent and Trademark Office's National Inventors Hall of Fame, celebrating individuals whose ideas have changed the world.

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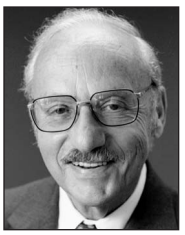
An obituary of George B. Dantzig



George B. Dantzig (Photo courtesy of Edward Souza, Stanford News Service.)

George Bernard Dantzig, the professor emeritus of operations research and of computer science, died 13 May at his Stanford home of complications from diabetes and cardiovascular disease. He was 90 years old.

In 1947, Dantzig devised the simplex method, an important tool for solving linear programming problems in diverse applications, such as allocating resources, scheduling production and workers, planning investment portfolios, and formulating marketing and military strategies.

In 1975, US President Gerald Ford awarded Dantzig a National Medal of Science. Ford said he was presenting the award

> for inventing Linear Programming and for discovering the Simplex Algorithm that led to wide-scale scientific and technical applications to important problems in logistics, scheduling and network optimization, and to the use of computers in making efficient use of mathematical theory.

Dantzig was a member of the National Academy of Sciences and the National Academy of Engineering. He was a fellow of the Econometric Society, the Institute of Mathematical Statistics, the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the Operations Research Society of America. He had been president of the Institute of Management Science and first chair of the Mathematical Programming Society. He received honorary doctorates from at least eight universities and wrote more than 120 technical articles.

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Clipboard

Members of our editorial board occasionally receive notices of self-publication or Web sites about the history of computing, and we thought it might benefit our readership to have access to these. Therefore, we will occasionally list such notable items in a sidebar that we call the "Clipboard."

In print

Roy Allan's book, *A History of the Personal Computer: The People and the Technology*, begins with the Altair computer and covers the products of a number of companies. These companies include the familiar manufacturers—such as IBM, Apple, and Dell—as well as the less successful firms, like Osborn. The book is available from Allan at 1624 Louise Blvd., London, Ontario, Canada, N6G 2R3. Readers may also contact him at rallan@execulink.com.

On the Web

In the April–June 2005 issue of *Annals*, we introduced Per Brinch Hansen's memoir, but the URL has changed. His memoir is now available at http://brinch-hansen.net/.

An obituary of Eiichi Goto

Eiichi Goto, who invented and worked on parametron devices including Quantum Flux Parametron (QFP) and the original parametron computer PC-1, passed away on 12 June 2005.

His contributions to science include inventing the computer language HLisp, developing the FLATS dedicated machine, work on double deflection tubes and variable shaping electron beam lithography systems, and participating in the search for magnetic monopoles.

In 1974, at the peak of an inernational debate that followed Edsger W. Dijkstra's article, "Go To Statement Considered Harmful," Knuth wrote, "Dr. Goto cheerfully complained that he was always being eliminated."[1]

Goto served as the Internation Federation for Information Processing (IFIP) vice president from August 1971 to July 1974 and was elected an honorary member of the Japan Society for the Promotion of Science (JSPS) in 1994. He continued to work up until the end of his life at the University of Tokyo, Kanagawa University, and the Institute of Physical and Chemical Research at Wako City.

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Reference

1. D. Knuth, "Structured Programming with Goto Statements," *ACM Computing Surveys*, vol. 6, no. 4, p. 264.